10-13-00 A

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No. 082225.P4249

First Named Inventor or Application Identifier Giles et al.

Express Mail Label No. EL695838575US

ADDRESS TO: **Assistant Commissioner for Patents**
Box Patent Application
Washington, D. C. 20231

APPLICATION ELEMENTS
See MPEP chapter 600 concerning utility patent application contents.

1. ____ Fee Transmittal Form
(Submit an original, and a duplicate for fee processing)

2. X Specification (Total Pages 20)
(preferred arrangement set forth below)
- Descriptive Title of the Invention
- Cross References to Related Applications
- Statement Regarding Fed sponsored R & D
- Reference to Microfiche Appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings (if filed)
- Detailed Description
- Claims
- Abstract of the Disclosure

3. X Drawings(s) (35 USC 113) (Total Sheets 8)

4. ____ Oath or Declaration/Power of Attorney (Total Pages ____)
   a. ___ Newly Executed (Original or Copy)
   b. ___ Copy from a Prior Application (37 CFR 1.63(d))
   (for Continuation/Divisional with Box 17 completed) **(Note Box 5 below)**
   i. ___ DELETIONS OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).

5. ____ Incorporation By Reference (useable if Box 4b is checked)
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

6. ____ Microfiche Computer Program (Appendix)

7. ____ Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
   a. ___ Computer Readable Copy
   b. ___ Paper Copy (identical to computer copy)
   c. ___ Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. _____ Assignment Papers (cover sheet & documents(s))

9. _____ 37 CFR 3.73(b) Statement (where there is an assignee)

10. _____ English Translation Document (if applicable)

11. _____ a. Information Disclosure Statement (IDS)/PTO-1449

_____ b. Copies of IDS Citations

12. _____ Preliminary Amendment

13. X Return Receipt Postcard (MPEP 503) (Should be specifically itemized)

14. _____ a. Small Entity Statement(s)

_____ b. Statement filed in prior application, Status still proper and desired

15. _____ Certified Copy of Priority Document(s) (if foreign priority is claimed)

16. X Other: Unsigned Declaration and Power of Attorney (5 pages)

17. **If a CONTINUING APPLICATION,** check appropriate box and supply the requisite information:

___ Continuation ____ Divisional ____ Continuation-in-part (CIP)

of prior application No: _____

18. **Correspondence Address**

_____ Customer Number or Bar Code Label _____ (Insert Customer No. or Attach Bar Code Label here)

or

X Correspondence Address Below

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October 11, 2000
Date of Deposit

Heather S. South
Name of Person Mailing Correspondence

Signature 10/11/00
Date

Serial/Patent No.: — Filing/Issue Date: —

Client: Sun Microsystems, Inc.

Title: A Server Node with Integrated Networking Capabilities

BSTZ File No.: 082225.P4249 Atty/Secty Initials: MAD|hss

Date Mailed: October 11, 2000 Docket Due Date: —

The following has been received in the U.S. Patent & Trademark Office on the date stamped hereon:

- ☐ Amendment/Response (____ pgs.)
- ☐ Appeal Brief (____ pgs.) (in triplicate)
- ■ Application - Utility (20 pgs., with cover and abstract)
- ☐ Application - Rule 1.53(b) Continuation (____ pgs.)
- ☐ Application - Rule 1.53(b) Divisional (____ pgs.)
- ☐ Application - Rule 1.53(b) CIP (____ pgs.)
- ☐ Application - Rule 1.53(d) CPA Transmittal (____ pgs.)
- ☐ Application - Design (____ pgs.)
- ☐ Application - PCT (____ pgs.)
- ☐ Application - Provisional (____ pgs.)
- ☐ Assignment and Cover Sheet
- ■ Certificate of Mailing
- ■ Declaration & POA (5 pgs.) unsigned
- ☐ Disclosure Docs & Orig & Copy of Inventors Signed Letter (____ pgs)
- ■ Drawings: 8 # of sheets includes 8 figures

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- ☐ Information Disclosure Statement & PTO-1449 (__ pgs.) ☐ Check No.____
- ☐ Issue Fee Transmittal Amt: ____
- ☐ Notice of Appeal
- ☐ Petition for Extension of Time
- ☐ Petition for ____
- ■ Postcard
- ☐ Power of Attorney (____ pgs.)
- ☐ Preliminary Amendment (____ pgs.)
- ☐ Reply Brief (____ pgs.)
- ☐ Response to Notice of Missing Parts
- ☐ Small Entity Declaration for Indep. Inventor/Small Business
- ■ Transmittal Letter, in duplicate
- ☐ Fee Transmittal, in duplicate

☐ Other: ____

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October 11, 2000
Date of Deposit

Heather S. South
Name of Person Mailing Correspondence

Signature 10/11/00
Date

UNITED STATES PATENT APPLICATION
FOR

A SERVER NODE WITH INTEGRATED NETWORKING CAPABILITIES

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A SERVER NODE WITH INTERATED NETWORKING CAPABILITIES

FIELD OF THE INVENTION

This invention relates to servers in general, and more specifically to a server node with integrated networking capabilities, such as switching, routing, load balancing and fail-over capabilities.

BACKGROUND OF THE INVENTION

Network applications have placed greater demands on network servers. These demands include greater reliability, increased capacity, and the ability to easily scale to meet increasing demand. For example, Internet Service Providers (ISPs) require server networks which are scalable and highly fault tolerant.

One popular method of meeting reliability and scalability requirements is to construct server farms where several servers are combined to function as a single unit. Figure 1 is a block diagram illustrating a prior art approach to combining multiple servers. In this example, six servers, S1-S6, are combined into a server farm. All servers S1-S6 are then connected to a shared switch 100.

Implementing such a server farm requires additional equipment. Figure 2 is a block diagram illustrating a prior art server farm architecture. In this example, servers S1 - S6 are combined and connected to switch 200. The switch 200 is then connected to a

router 202 through a load balancer 201. The router 202 is also connected to a modem pool 204 and external networks such as the Internet 203.

However, this approach has some drawbacks. First, the various pieces of equipment such as servers, switches, routers and modems all take up space. Since, in many applications space is at a premium, a small footprint is needed. Secondly, switches have a limited number of ports. Therefore, scalability is somewhat limited. In order to add servers beyond the number of ports available on a given switch, additional switches will be required. This in turn may require the addition of more load balancers and routers. Additionally, a switch creates a single point of failure. Failure of a switch will make all servers connected to it unavailable. Sometimes redundant switches are used to address this problem but this approach further complicates scalability. Finally, external connections between the devices in such an application are slower than internal connections within a single device.

SUMMARY OF THE INVENTION

A server node with integrated networking capabilities is disclosed. According to one embodiment of the present invention, server nodes consist of one or more processors. The processors are configured to perform server functions as well as switch and router functions (e.g., network functions) including load balancing and fail-over. The server nodes also have a plurality of ports. These ports allow the server nodes to be combined to form blocks and networks as well as to provide connections to external networks.

According to another aspect of the invention, a method and apparatus for a server block is disclosed. A server block consists of a plurality of server nodes and a plurality of signal paths connected with the ports of each server node. At least one path connected with each node provides an external connection to the server block and at least two paths connected with each node are connected with other server nodes in the block. When a server node receives a request, it determines whether it can handle the request. If possible, the server node handles the request. If the server node cannot handle the request, it routes the request to a second, neighboring server node.

According to another aspect of the invention, a scalable, fault tolerant server node network topology may be constructed by interconnecting server blocks in a mesh-like topology. This computer network consists of a plurality of server blocks and a plurality of signal paths connected with the server blocks. At least one signal path connected with each server block provides an external connection to the network and at least two signal

paths connected with each server block are connected with other server blocks in the network.

BRIEF DESCRIPTION OF THE DRAWINGS

The appended claims set forth the features of the invention with particularity. The invention, together with its advantages, may be best understood from the following detailed description taken in conjunction with the accompanying drawings of which:

Figure 1 is a block diagram illustrating a prior art approach to combining multiple servers;

Figure 2 is a block diagram illustrating a prior art server farm architecture;

Figure 3 is a block diagram conceptually illustrating interconnection of server nodes according to one embodiment of the present invention;

Figure 4 is a flowchart illustrating switching and routing functions of a server node according to one embodiment of the present invention;

Figure 5 is a block diagram illustrating physical interconnection of server node cards within a card rack according to one embodiment of the present invention;

Figure 6 is a block diagram conceptually illustrating interconnection of multiple server blocks according to one embodiment of the present invention;

Figure 7 is a block diagram illustrating physical interconnection of multiple server blocks within multiple card racks according to one embodiment of the present invention; and

Figure 8 is a block diagram of a server node board according to one embodiment of the present invention.

DETAILED DESCRIPTION

A server node with integrated networking capabilities is disclosed. According to one embodiment of the invention, a server node consists of one or more processors. The processors are configured to perform server functions as well as switch and router functions. The server nodes also have a plurality of ports. These ports allow the server nodes to be connected combined to form blocks and networks as well as to provide connection to external networks. When a server node receives a request, it determines whether it can handle the request. If possible, the server node handles the request. If the server node cannot handle the request, it routes the request to a second, neighboring server node.

According to another embodiment of the invention, a novel grouping and interconnection of server nodes, referred to as a "server block" is disclosed. A server block consists of a plurality of server nodes and a plurality of signal paths connected with the ports of each server node. At least one path connected with each node provides an external connection to the server block and at least two paths connected with each node are connected with other server nodes in the block.

According to another embodiment of the invention, a scalable, fault tolerant server node network topology is disclosed. This server node network topology consists of

a plurality of server blocks and a plurality of signal paths connected with the server blocks. At least one signal path connected with each server block provides an external connection to the network and at least two signal paths connected with each server block are connected with other server blocks in the network.

In the following description, for the purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will be apparent, however, to one skilled in the art that the present invention may be practiced without some of these specific details. In other instances, well-known structures and devices are shown in block diagram form.

The present invention includes various steps, which will be described below. The steps of the present invention may be performed by hardware components or may be embodied in machine-executable instructions, which may be used to cause a general-purpose or special-purpose processor or logic circuits programmed with the instructions to perform the steps. Alternatively, the steps may be performed by a combination of hardware and software.

As explained above, one method used to increase reliability and scalability has been to combine multiple servers into a server farm. This approach has drawbacks such as requiring large amounts of physical space and reduced reliability due to failures in shared equipment such as routers and switches. The present invention, instead of using separate pieces of equipment, uses a server with an integrated switch. Further, this switch includes some routing and load balancing functions. These server nodes can then be combined to

form a block of servers (a "server block") that performs many of the same functions of the traditional server farms. Further, these server blocks can then be combined to build larger networks of servers that are compact in size and highly fault tolerant.

Figure 3 is a block diagram conceptually illustrating interconnection of server nodes according to one embodiment of the present invention. This block of server nodes 300 consists of six server nodes SN1-SN6. Each server node has four ports. Server node SN1, for example, is interconnected with nodes SN2, SN3 and SN6 and one port is used for an external connection 301. Other nodes are interconnected in a similar fashion. For example, server node SN4 is interconnected with nodes SN3, SN6, and SN5 and one port is used for an external connection 308. While all nodes SN1-SN6 have four ports, not all nodes are connected to three other nodes. For example, server node SN2 is connected to two other server nodes SN1 and SN3 and has two external connections 302 and 303. Likewise, server node SN5 is connected to two other server nodes SN4 and SN6 and has two external connections 306 and 307.

Each node in the block 300 performs normal server function as well as switching, routing, load balancing, and fail-over functions. Routing gives loop free paths and automatic dealing with failed nodes but no load balancing. Load balancing can be handled in various manners but in the preferred embodiment this function is performed as detailed in co-pending U.S. Patent Application No. _____, entitled "Load-Balancing Anycasting and Routing In a Network" filed on _____. To summarize, in this embodiment, load balancing is performed by continuously calculating the load, response

time and link traffic load on all possible connections and picking the one that, at this point in time, can provide the quickest response. Because this is a distributed calculation, each node does not need to know how to access all other nodes, it only needs to know how to access its neighboring nodes. Therefore, routing tables can be very small since a node only needs to know its immediate neighbors and not the entire network.

Figure 4 is a flowchart illustrating switching and routing functions of a server node according to one embodiment of the present invention. First, at processing block 400, a server node receives a request. This request may be from another, neighboring server node or an external network such as the internet. The server node then determines whether it can handle this request at decision block 410. This determination may be based on the present load of the server node, whether requested information is locally available on the server node, or other considerations. If the server node is able to handle the request it does so at processing block 420. If unable to handle the request, then at processing block 430, the server node determines the present load of each available neighboring server node and routes the request to the server node with the lightest load at processing block 440.

Figure 5 is a block diagram illustrating physical interconnection of server node cards within a card rack 516 according to one embodiment of the present invention. In this example, the card rack 516 implements server node block 500 which consists of six server nodes SN1-SN6. Each server node is constructed on a card represented as 509-515 that could be stored in the card rack 516. Additionally, each block includes an interface

card 515. This interface card 515 provides all external connections and provides all necessary buffering. Connections between all server node cards 509-514 and between server node cards and the interface card 515 can then be made through a series of jumpers on the back of each card in the card rack 516. For example, server node card SN1 is connected to server node cards SN2, SN3, and SN6 through jumpers 525-527 and to the interface card 515 through jumper 528. The other cards in the rack are connected in similar fashion to construct the server block 500.

Several server blocks 500 can be interconnected to form a larger network of servers. Figure 6 is a block diagram conceptually illustrating interconnection of multiple server blocks according to one embodiment of the present invention. Here, four server blocks 610-640 are interconnected to form a server network. In such a network, at least two nodes of a block are connected to at least two nodes of another block. In the example illustrated in Figure 6, block 610 is connected with block 620 and block 630. Server node SN2 of block 610 is connected to server node SN4 of block 620 and server node SN3 of block 610 is connected to server node SN5 of block 620. Likewise, server node SN5 of block 610 is connected to server node SN1 of block 630 and server node SN6 of block 610 is connected to server node SN2 of block 630. Further, in this example, block 620 and block 630 are connected in a similar manner to block 640.

Each server block 610-640 has a total of eight external connections A-H. Those connections not used for interconnecting to another server block are available for connection to an external network. For example, block 610 has four connections available

for connection to an external network A, B, G, and H. Each of the other blocks 620-630 likewise have four connections available for connection to an external network. Block 620 has connections A-D, block 630 has connections E-H and block 640 has connections C-F all available for connection to an external network.

As explained above, each server node is connected to at least two other server nodes in the network. Further, each server node has integral switching and routing capabilities. Interconnections of server blocks as illustrated in Figure 6 makes efficient use of the switching and routing capabilities of the individual server nodes and creates a highly fault tolerant server network. For example, if server node SN5 of block 620 were to fail, the network could still operate normally. Once server node SN5 of block 620 failed, the neighboring nodes such as server nodes SN4 and SN6 of block 620, SN3 of block 610, and SN1 of block 640 would detect the failure and remove the failed nodes from their routing tables. Transactions passing through the neighboring nodes could then be routed around the failed node and thereby allow the network to function with a minimum of disruption.

A network constructed of servers nodes having four ports in the manner illustrated with reference to figure 6 will have some practical size limitations. Using server nodes with four ports limits the network size to approximately 200 nodes. In alternative embodiments of the present invention, each server node may have more than four ports. For example, each server node may have six ports. With six ports, the basic server block structure illustrated with reference to figure 3 may be maintained with the addition of two

more ports available for connection to other blocks. These additional ports can be used to extended the network described with reference to figure 6 into a three dimensional topology. By using server nodes with six ports and a three dimensional topology, highly fault tolerant networks can be constructed which use up to 512 server nodes.

As explained above, each server node can be constructed on a single printed circuit board that can then be mounted in a card rack and configured to form a server block. These rack mounted server blocks can then be interconnected to form a server network. Figure 7 is a block diagram illustrating physical interconnection of multiple server blocks within multiple card racks according to one embodiment of the present invention. In this example, four blocks block 710 - block 740 are illustrated. Each block constructed in a card rack consists of server node cards 700 and an interface card 701. The interface cards 701 provide connections to external networks or devices as well as allow interconnection to other blocks 703 to form a server network. In this manner, a highly fault tolerant and easily scalable network can be built.

Figure 8 is a block diagram of a server node board according to one embodiment of the present invention. Each server node 800 contains a main processor 810 and a network interface processor 825. The main processor 810 with its dedicated memory 815 is connected through bus A 840 to a mass storage interface 805. This interface 805 provides a connection 850 to external storage devices (not shown) such as disk arrays. The main processor 810 is connected through bus B 845 to the network interface processor 825, shared memory 830, and system flash memory 835. The system flash

memory 835 provides system operation instructions to both the main processor 810 and the network interface processor 825. The network interface processor 825 with its dedicated memory 820 provides the server node ports 855 and performs network functions including switching, routing, load balancing and fail-over processing. The shared memory 830 is used by both the main processor 810 and the network interface processor 825. This memory 830 is used to store message packets sent and received through the network interface processor 825.

CLAIMS

What is claimed is:

1. An apparatus comprising:

one or more processors, the one or more processors configured to perform server functions and switch and router functions including load balancing and fail-over; and

a plurality of ports coupled with the one or more processors

2. The apparatus of claim 1, wherein said server node comprises a single printed circuit board

3. The apparatus of claim 1, where the plurality of ports comprises four ports.

4. The apparatus of claim 2, wherein the printed circuit board is rack mountable and the plurality of ports are accessible as connection points on the card rack.

5. A server block comprising:

a plurality of server nodes, each server node comprising a server with integrated switching, routing, load balancing and fail-over functions and a plurality

of ports, at least one port of the plurality of ports configured for connection to an external network; and

a plurality of signal paths connected with the plurality of ports of the server nodes of the plurality of server nodes, at least two of the plurality of ports of each server node of the plurality of server nodes connected with another server node of the plurality of server nodes in the server block.

6. The apparatus if claim 5, wherein each said server node of the plurality of server nodes comprises one printed circuit board.

7. The apparatus of claim 6, wherein the printed circuit board is rack mountable and the plurality of ports of each server node of the plurality of server nodes are accessible as connection points on the card rack and the server block is constructed in one card rack by interconnecting the connection points on the card rack.

8. The apparatus of claim 7, wherein the external connections of the server block are provided through an interface card in the card rack, the interface card being connected to the plurality of server nodes through connection points on the card rack.

9. A computer network comprising:

a plurality of server blocks wherein each server block comprises;

a plurality of server nodes, each server node comprising a server with integrated switching, routing, load balancing and fail-over functions and a plurality of ports, and

a plurality of signal paths connected with the plurality of ports of each server node of the plurality of server nodes, at least one signal path connected with each server node of the plurality of server nodes providing an external connection to a server block, and at least two signal paths of the plurality of signal paths connected with each server node of the plurality of server nodes being connected with other server nodes of the plurality of server nodes in the block; and

a plurality of signal paths connected with the server blocks, at least one signal path connected with each server block of the plurality of server blocks providing an external connection to the network, and at least two signal paths of the plurality of signal paths connected with each server block of the plurality of server blocks being connected with other server blocks of the plurality of server blocks.

10. The apparatus of claim 9, wherein each server node of the plurality of server nodes comprises one printed circuit board.

11. The apparatus of claim 10, wherein the printed circuit board is rack mountable and the plurality of ports of each server node of the plurality of server nodes are accessible as connection points on the card rack and a server block is constructed in one card rack by interconnecting the connection points on the card rack.

12. The apparatus of claim 11, wherein the external connections of the plurality of server blocks are provided through an interface card in the card rack, the interface card being connected to the plurality server nodes through connection points on the card rack.

13. A method of operating a first server node comprising:
receiving a request;
determining whether to service the request;
if unable to service the request, routing the request to a second server node coupled with the first server node.

14. The method of claim 13, wherein determining whether the first server node can service the request is based on the present load of the first server node.

15. The method of claim 13, wherein routing further includes load balancing.

16. The method of claim 15, wherein load balancing comprises:

determining the present load of one or more other server nodes coupled with the first server node; and

routing the message to the server node of the one or more server nodes with the lightest load.

17. A machine-readable medium having stored thereon data representing sequences of instructions, the sequences of instructions which, when executed by a processor, cause a first server node to:

receive a request;

determine whether to service the request;

if unable to service the request, route the request to a second server node coupled with the first server node.

18. The machine-readable medium of claim 17, wherein determining whether the first server node can service the request is based on the present load of the first server node.

19. The machine-readable medium of claim 17, wherein routing further includes load balancing.

20. The machine-readable medium of claim 19, wherein load balancing further comprises:

determining the present load of one or more other server nodes coupled with the first server node; and

routing the message to the server node of the one or more server nodes with the lightest load.

ABSTRACT

According to one aspect of the invention, a method and apparatus for a server node is disclosed. This server node consists of one or more processors. The processors are configured to perform server functions as well as switch and router functions including load balancing and fail-over. The server nodes also have a plurality of ports. These ports allow the server nodes to be connected combined to form blocks and networks as well as to provide connection to external networks. When a server node receives a request, it determines whether it can handle the request. If possible, the server node handles the request. If the server node cannot handle the request, it routes the request to a second, neighboring server node.

According to another aspect of the invention, a method and apparatus for a server block is disclosed. This server block consists of a plurality of server nodes and a plurality of signal paths connected with the ports of each server node. At least one path connected with each node provides an external connection to the server block and at least two paths connected with each node are connected with other server nodes in the block.

According to another aspect of the invention, a method and apparatus for a computer network is disclosed. This computer network consists of a plurality of server blocks and a plurality of signal paths connected with the server blocks. At least one signal path connected with each server block provides an external connection to the network and at least two signal paths connected with each server block are connected with other server blocks in the network.

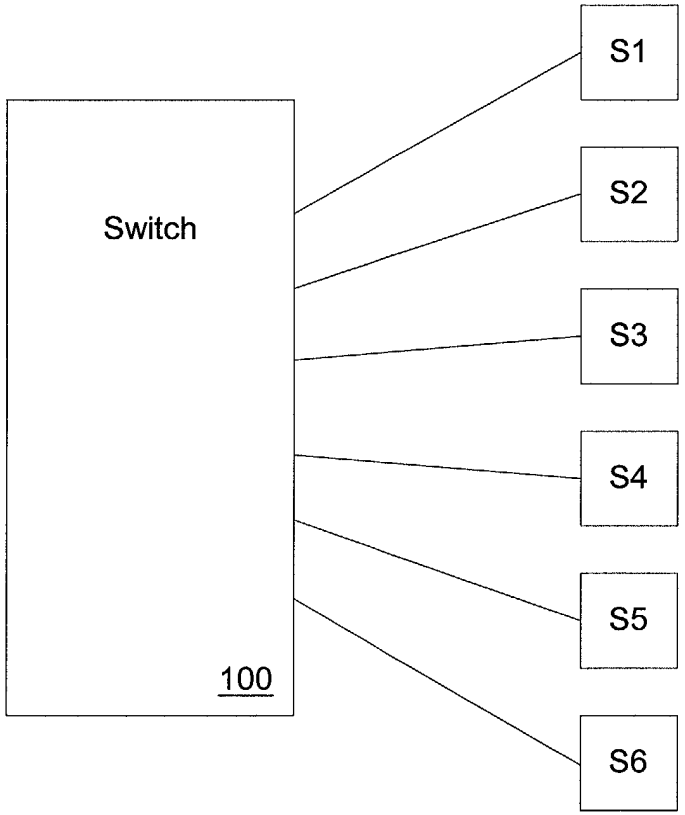


Figure 1
(Prior Art)

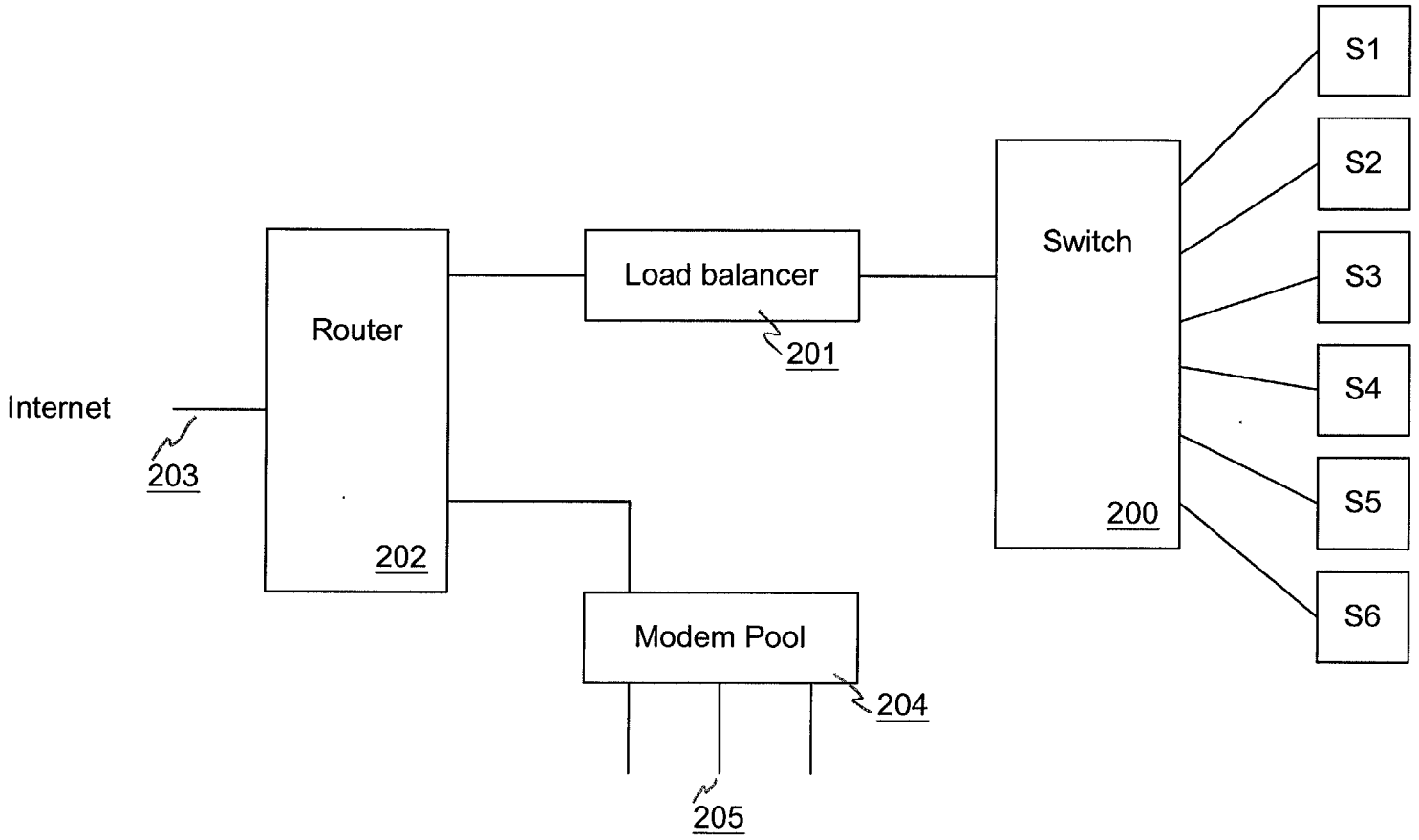
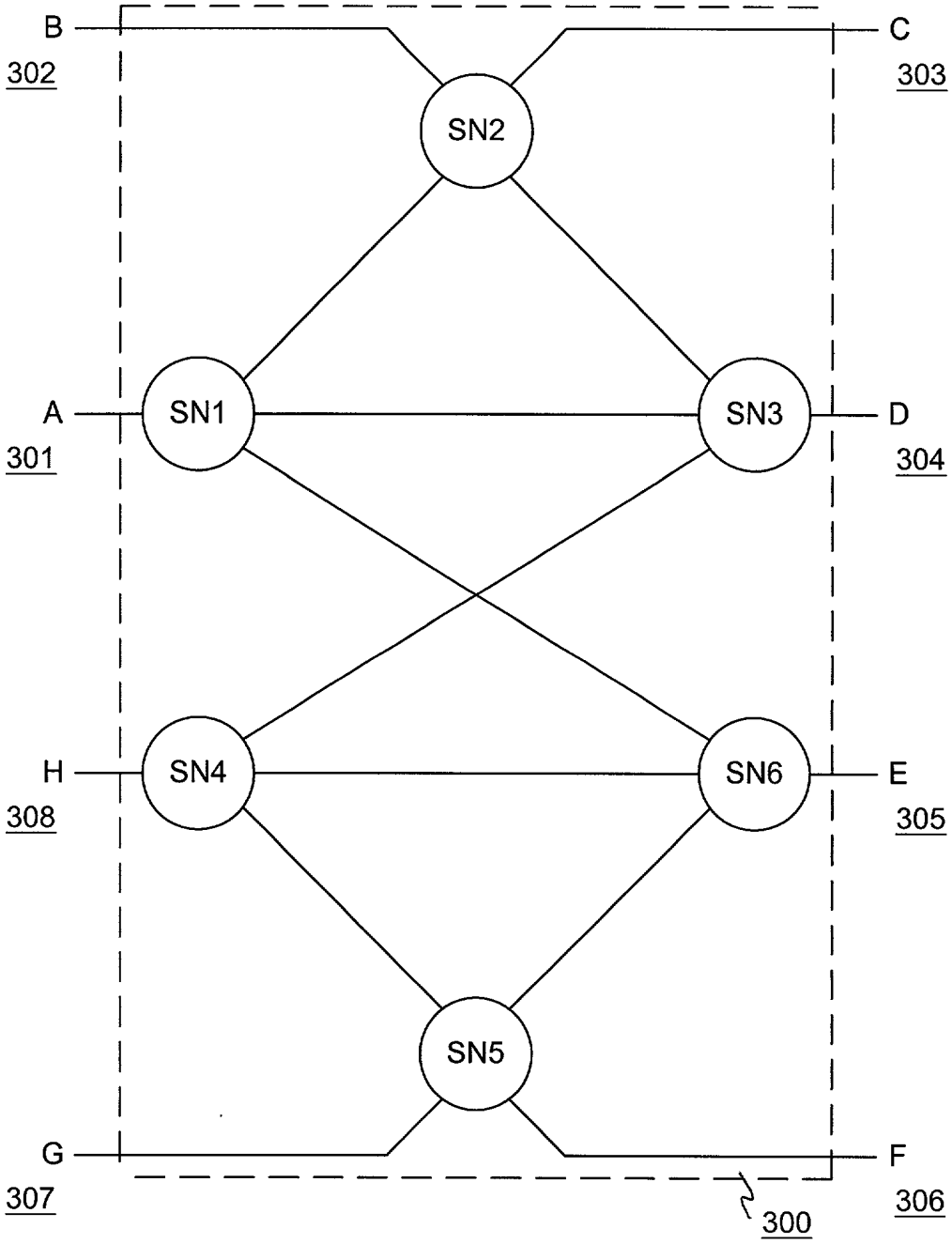


Figure 2
(Prior Art)


B
302
C
303
SN2
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305
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G
307
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306
300

Figure 3

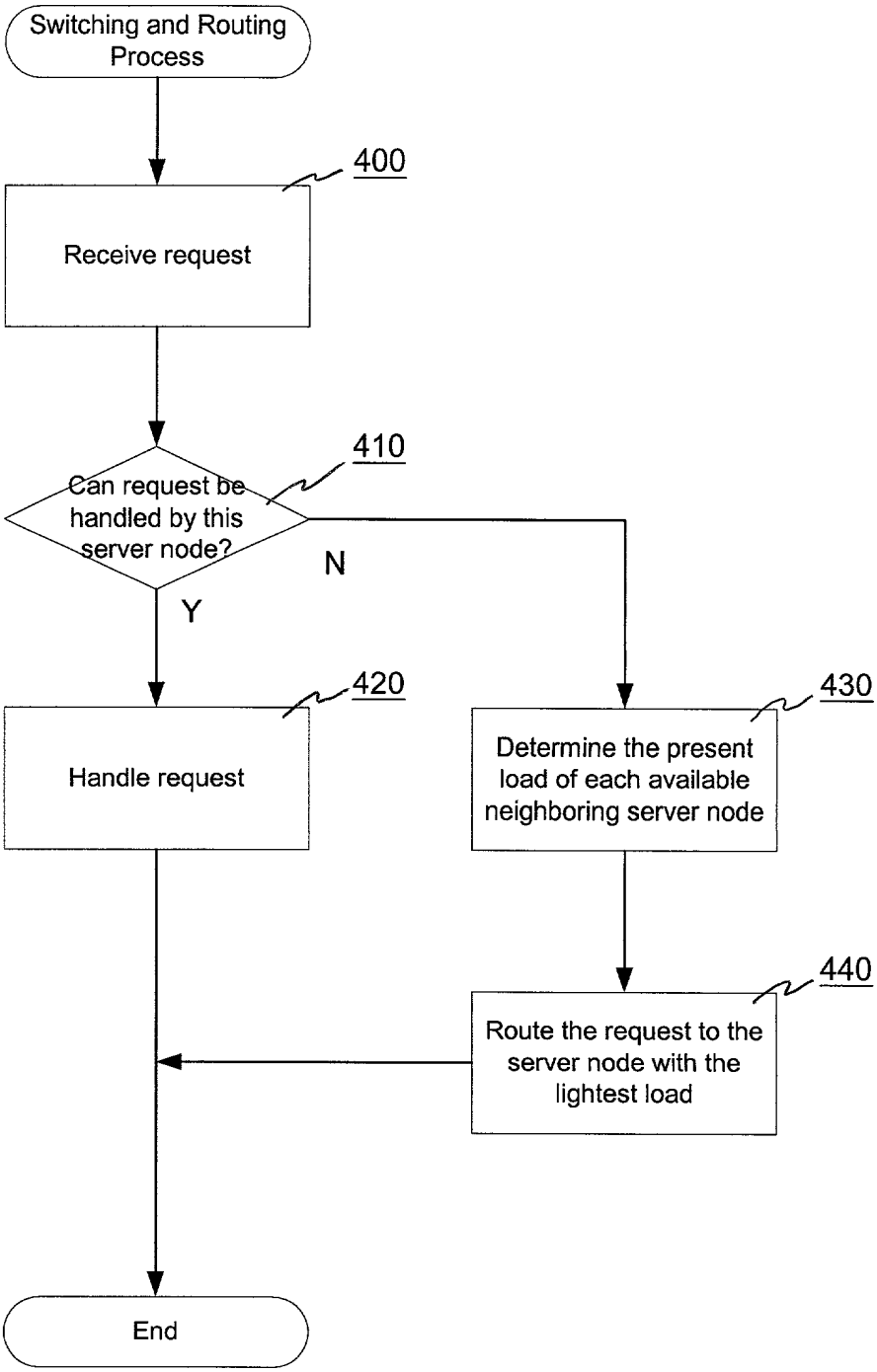
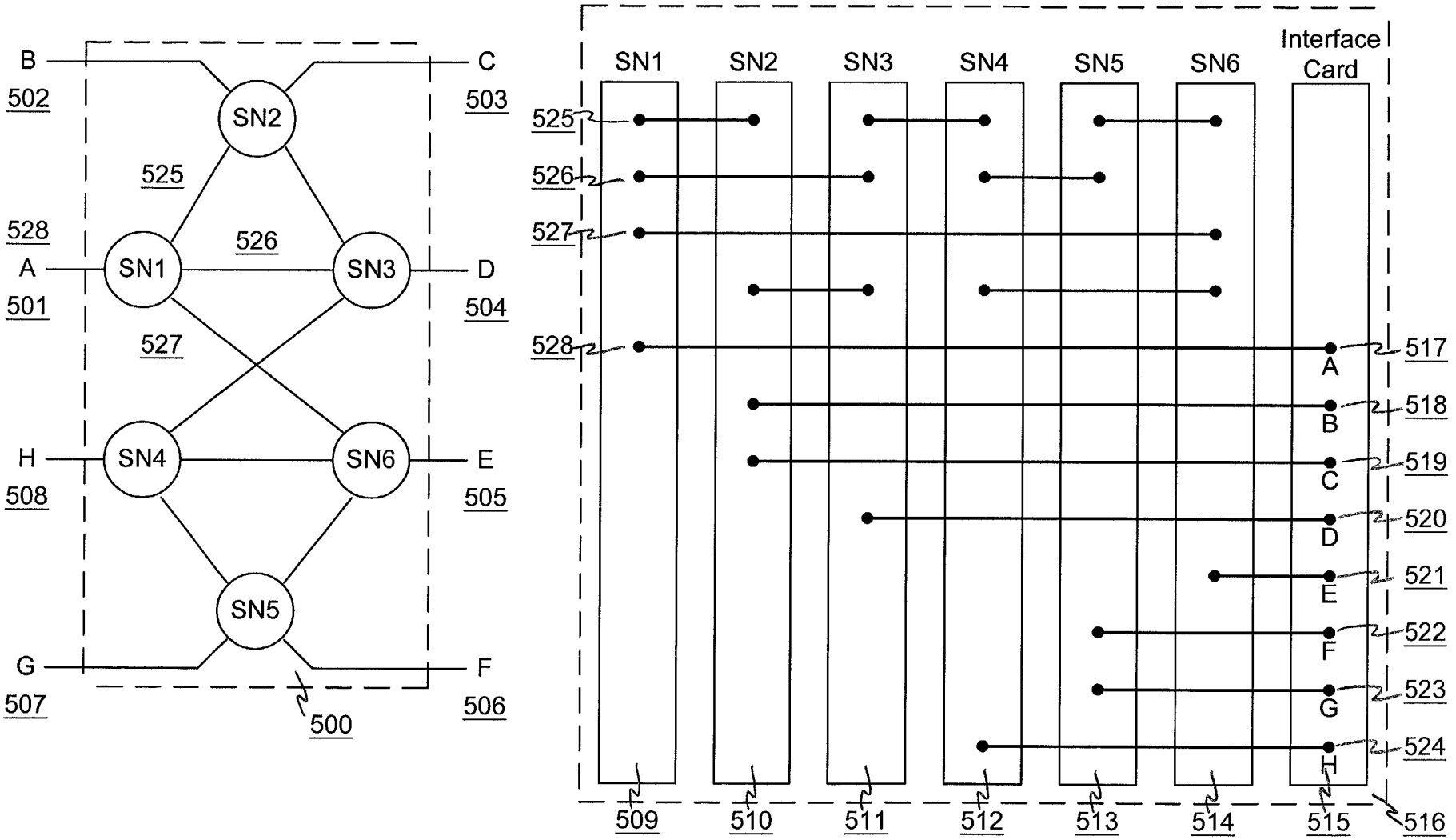

Switching and Routing Process
400
Receive request
410
Can request be handled by this server node?
N
Y
420
Handle request
430
Determine the present load of each available neighboring server node
440
Route the request to the server node with the lightest load
End

Figure 4


B
502
C
503
SN2
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528
A
501
SN1
526
SN3
D
504
527
H
508
SN4
SN6
E
505
SN5
G
507
F
506
500
SN1
SN2
SN3
SN4
SN5
SN6
Interface Card
525
526
527
528
517
A
518
B
519
C
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G
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H
509
510
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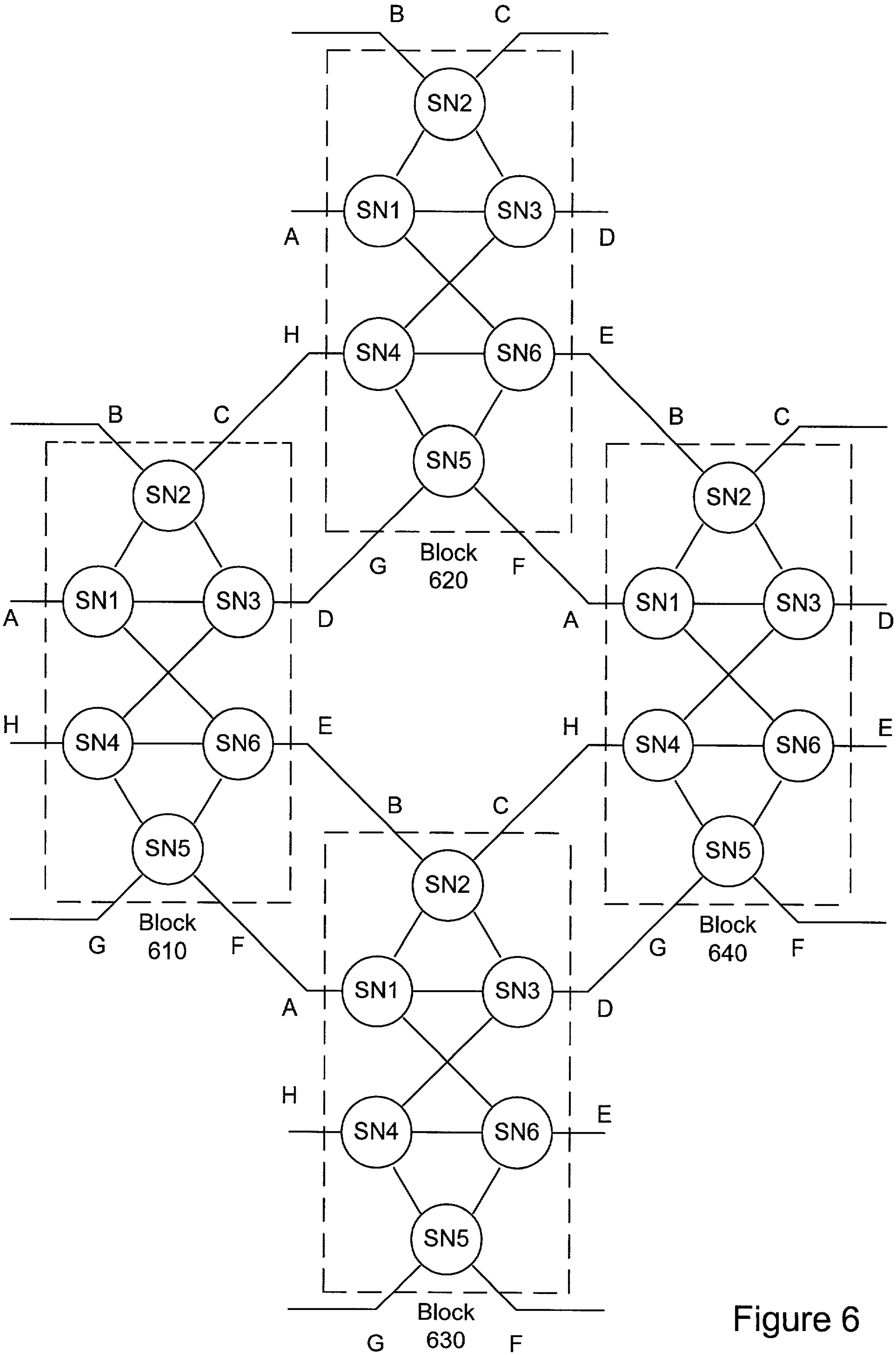
512
513
514
515
516

Figure 5



B
C
SN2
SN1
SN3
A
D
H
E
SN4
SN6
SN5
Block
620
G
F
Block
610
Block
630
Block
640

Figure 6

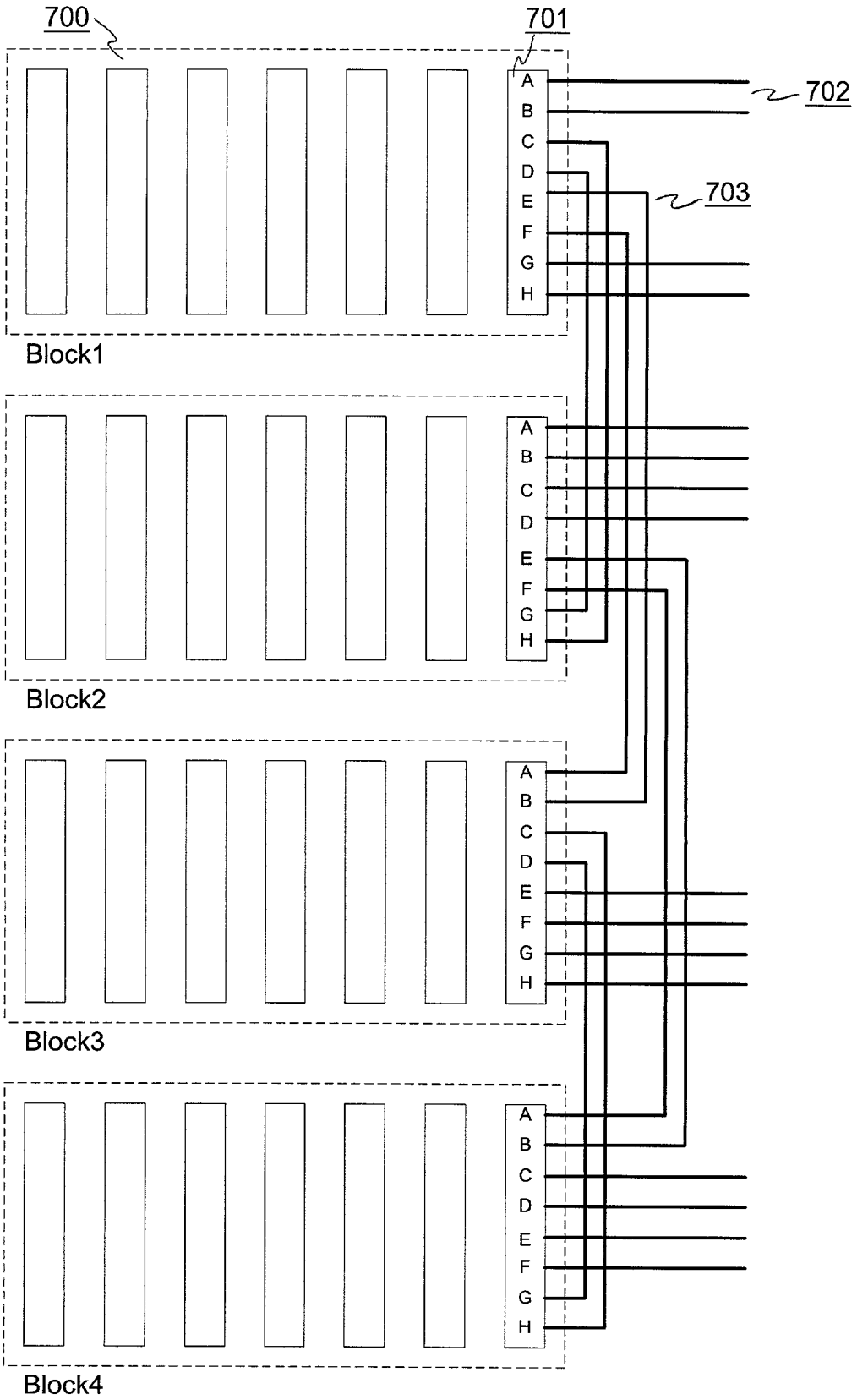


Figure 7

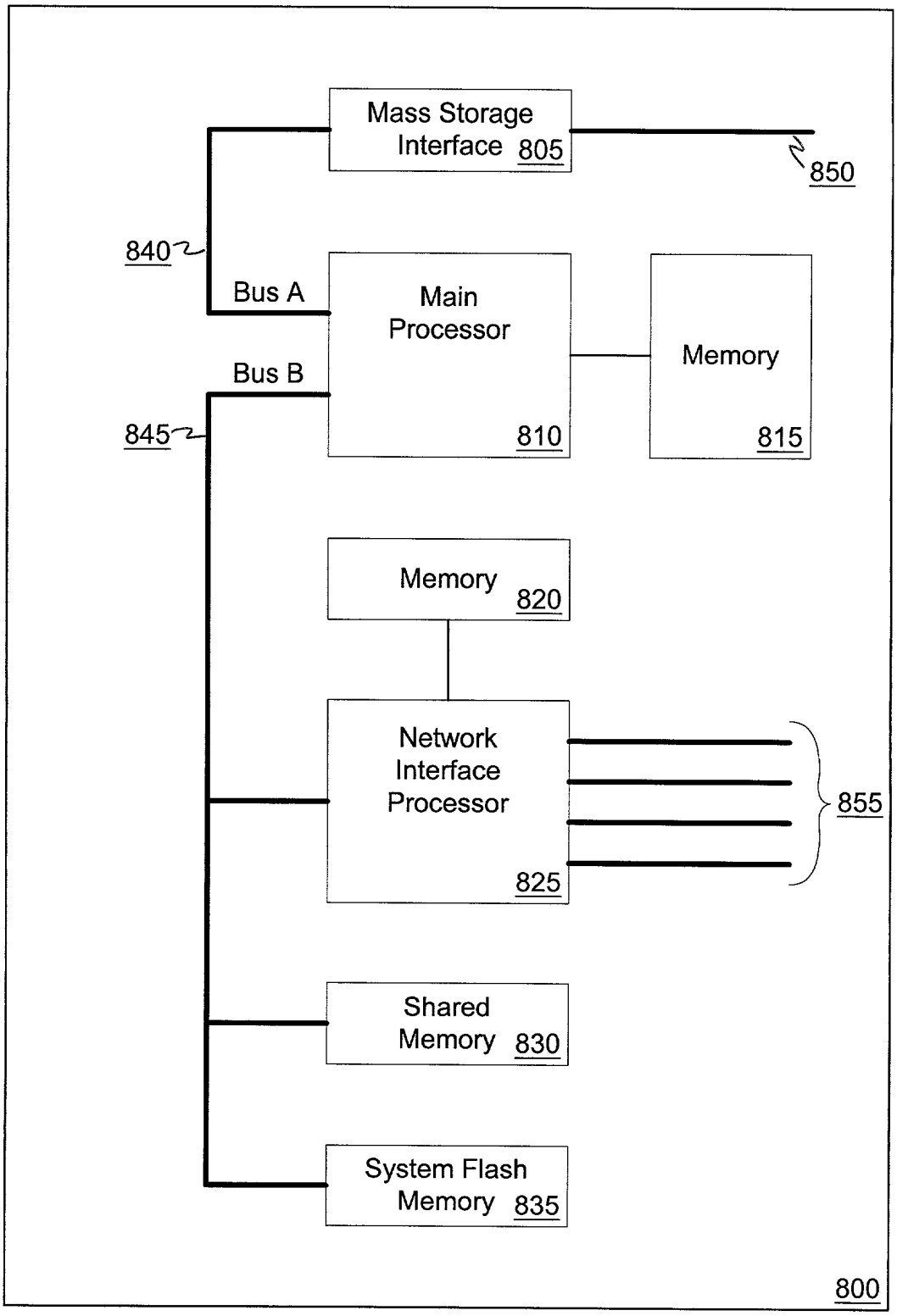

Mass Storage Interface 805
850
840
Bus A
Main Processor
Memory
Bus B
845
810
815
Memory 820
Network Interface Processor
855
825
Shared Memory 830
System Flash Memory 835
800

Figure 8

Attorney's Docket No.: 082225.P4249 Patent

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

A SERVER NODE WITH INTEGRATED NETWORKING CAPABILITIES

the specification of which

_X_ is attached hereto.
___ was filed on _____ as
United States Application Number _____
or PCT International Application Number _____
and was amended on _____.
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I do not know and do not believe that the claimed invention was ever known or used in the United States of America before my invention thereof, or patented or described in any printed publication in any country before my invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, and that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (for a utility patent application) or six months (for a design patent application) prior to this application.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d), of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

EXPRESS MAIL CERTIFICATE OF MAILING

"Express Mail" mailing label number: EL695838575US
I hereby certify that I am causing this paper or fee to be deposited with the United States Postal Service "Express Mail Post Office to Addressee" service on the date indicated above and that this paper or fee has been addressed to the Assistant Commissioner for Patents, Washington, DC 20231.

October 11, 2000
Date of Deposit

Heather S. South
Name of Person Mailing Correspondence

Signature 10/11/00
Date

Prior Foreign Application(s)			Priority Claimed	
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No

I hereby claim the benefit under title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below:

(Application Number)	Filing Date
(Application Number)	Filing Date

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Number)	Filing Date	(Status -- patented, pending, abandoned)
(Application Number)	Filing Date	(Status -- patented, pending, abandoned)

I hereby appoint the persons listed on Appendix A hereto (which is incorporated by reference and a part of this document) as my respective patent attorneys and patent agents, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

Send correspondence to Michael A. DeSanctis, BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP, 12400 Wilshire Boulevard 7th Floor, Los Angeles, California 90025 and direct telephone calls to (303) 740-1980.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Inventor's Signature _____ Date _____

Residence _____ (City, State) Citizenship _____ (Country)

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APPENDIX A

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APPENDIX B

Title 37, Code of Federal Regulations, Section 1.56
Duty to Disclose Information Material to Patentability

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclosure information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclosure all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) Prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) The closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made or record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application;

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.